Frame-based guide to situated decision-making on climate change[*]

Paper to be submitted for review

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Abstract

The present paper describes a frame-based approach to situated-decision-making on climate change. Based on the multidisciplinary literature on the relationship between frames and decision-making, it argues that members of a decision unit may gain from making frames more explicit. Frames are the organizing principles of perception that shape in a "hidden" and taken-for-granted way how people develop a particular conceptualization of an issue. Science-related issues, such as climate change, are often linked to a few frames that consistently appear across different policy areas. Indeed, it appears that there are some very contrasting ways in which climate adaptation may be framed. These frames can be characterized in terms of a simple framework that highlights specific interpretations of climate issues. A second framework clarifies the built-in frames of decision-tools. Using Thompson's two basic dimensions of decision, it identifies the main uncertainties that should be taken into account in developing a decision strategy. The paper characterizes four types of decision strategy, focusing on (1) computation, (2) compromise, (3) judgment, or (4) inspiration, and links each strategy to the most appropriate methods and tools, as well as the most appropriate social structure. Our experiences show that the frame-based guide can work as an eye-opener for members of a decision unit, particularly where it demonstrates how to add more perspectives to the decision.

Introduction

One of the main characteristics of decision-making on climate change adaptation is that the impacts of policy options appear to be very context specific (Dempsey & Fisher, 2005; Halsnæs et al., 2007; Kirshen, Ruth, & Anderson, 2008). This is partly due to the complexities of climate change itself, which may cause considerable uncertainty over climate change projections and its impacts (Dessai & Hulme, 2004; Lempert, Nakicenovic, Sarewitz, & Schlesinger, 2004). Also the role of other human-caused environmental changes, such as changes in regional land use patterns, can make a large difference. In particular, it is the specific combination of climate change and other environmental changes that may create the most significant impacts

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[*] Presented at the IARU International Scientific Congress on Climate Change: Global Risks, Challenges and Decisions, Copenhagen, 12 March 2009.

for society. Consequently, members of a decision unit who have the responsibility or authority to search for solutions should develop a strategy that is informed by a rich store of information and, at the same time, ensures a sufficient degree of flexibility and adaptability (Lindblom, 1990; Thompson & Tuden, 1959; Thompson, 2003). Whether the strategy for decision-making can stand in the service of adequate action will strongly depend on the way in which the members of the decision unit and the stakeholders frame the specifics of the situation, including the time lines (Robinson et al., 2006; Schlumpf, Pahl-Wostl, Schönborn, Jaeger, & Imboden, 2001). However, the actors involved in this process may not be sufficiently aware that "taken-for granted" frames, including the frames that are "built-in" in decision tools, can subtly shape the selectivity and organization of information. Therefore, based on the multidisciplinary literature about these topics, the present paper will examine how decisions may gain from making frames more explicit.

A frame-based guide to situated decision-making may be particularly helpful where thinking about climate change at a distal level has to be supplemented by thinking at a proximal level. In the recent past, uncertainty about climate change may have lead people to conceptualize it in terms of abstract and distal properties (Bord, Fisher, & O'Connor, 1998). This response agrees with general patterns of differences between distal and proximal levels of thinking (Liberman & Trope, 2008; Wakslak & Trope, 2009). Thinking at a proximal level may require, for instance, that several conditions of uncertainty have to be accepted. Instead of just focussing on the question "How can we reduce uncertainty in our estimates of future climatic conditions?" it is important to give more attention to the question "Given that there is considerable uncertainty about our future, how can we best manage this coastal area to reduce risk and increase system resilience?" Obviously, the first question can be an excuse for delaying action. In contrast, the latter question is far more action related. In fact, the two questions are based on divergent implicit frames. It is their contrasting impact that demonstrates why situated decision-making may be facilitated by making frames and frame-based decision-strategies more explicit.

After a short explanation of frames – in particular frames that are relevant for discussions on science-related issues, such as climate change – the next sections of the paper will address some critical choices and assumptions of decision-making. One of the most important choices is selecting a decision strategy, which, in turn, may shape the choices of appropriate methods and tools, as well as the social structure that fits the process. Our approach has been developed in interaction with a number of adaptation projects at the regional level, but a description of these cases is beyond the scope of this paper.

Frames applied to science-related issues

Although there are slight differences between various definitions (Barsalou, 1999; Chong & Druckman, 2007; Graf, 2006), frames are generally conceived as organizing principles of perception that shape in a "hidden" and taken-for-granted way how people develop a particular conceptualization of an issue. Seen in this way, frames are not just personal mindsets but also cultural structures. Frames are crucial

micro-mechanisms for perception, knowledge, communication and decision-making, not only at the level of individuals but also at the level of policy-making processes. They are the topic of research in such varied fields as anthropology, linguistics, cognitive psychology, social and organizational psychology, management science, sociology, communication and media studies, social movements research, policy science, science studies, and philosophy. In the literature on policy controversies (Schön & Rein, 1994), frames are depicted in terms of "underlying mental structures" of belief, perception and appreciation, which enable people to take shared or opposing political positions.

The way in which decision-makers and stakeholders think about climate change may reveal several relevant frames. Because climate change is still very much a scientific issue, it is one of the policy areas that regularly generate debates among scientists and non-scientists. Social scientists who have analyzed public discussions on science-related issues argue that these issues are often linked to a few frames that consistently appear across different policy areas (Gamson & Modigliani, 1989; Nisbet, 2009). For example, synthetic pesticides, such as DDT, have been framed as a blessing for humanity (before the year 1962), but also as Pandora's box (after the publication of Rachel Carson's *Silent Spring* in 1962), as a matter of specific risks and benefits to be decided on scientific evidence (with the rise of ecotoxicology as a science in the 1980s and 1990s), and as a key factor to keep certain industries competitive (along with each new pesticide regulation).

The frames that are applied to science-related issues suggest that there are some very contrasting ways in which climate adaptation may be interpreted. Based on the view that interpretations are inherently perceptual (e.g. Barsalou, 1999), two perceptual contrasts can be used to make their meaning more transparent. The two contrasts lay the ground for a simple framework that highlights specific interpretations of climate issues. The first contrast is the difference between a promotion or prevention orientation to goal-directed behaviour; the second involves taking a distal or proximal view on an object.

Generally, a promotion orientation makes the person sensitive to positive outcomes and hits that may be gained through aspirations, accomplishments, and ideals (Higgins, 1997; 2000). In contrast, a prevention orientation makes the person sensitive to negative outcomes and errors that have to be avoided by fulfilling one's moral obligations and responsibilities. This difference is not just a matter of personal mindsets – the orientations can be associated with certain institutions, subcultures within an organization, or occupational groups. Engineers, for example, are said to be safety oriented and inclined to "overdesign" for safety (Schein, 1996).

In line with the second contrast, taking a distal (versus a proximal) view on an object may evoke broad categories to represent its general features rather than its more contextual and incidental aspects (Liberman, Trope, McCrea, & Sherman, 2007). This may include more abstract moral principles to judge the object. In contrast, a proximal view induces categories that are narrower to represent more detailed and contextualized features. A proximal view is also more constrained by concrete

realities (Goldstone & Barsalou, 1998). Again, these perceptual differences also have cultural relevance. They are closely related to differences between holistic and analytical ways of thinking, each of which may have become more useful and more available in one culture than in another. For instance, Easterners tend to engage more in holistic perceptual processes whereas Westerners tend to engage more in analytical ones (Nisbett, 2003).

Figure 1 combines the two perceptual contrasts and presents four cells that reflect promotion or prevention orientations in combination with a distal or a proximal view. Building on that framework, Figure 2 captures the different frames that may underlie discussions on science-related issues. In addition, each cell provides an example of a matching climate-related issue.

	Promotion orientation	Prevention orientation
Distal view	Using broad categories to represent general features and focusing on gaining positive outcomes (hits)	Using broad categories to represent general features and focusing on avoiding negative outcomes (errors)
Proximal view	Using narrow categories to represent contextualized features and focusing on gaining positive outcomes (hits)	Using narrow categories to represent contextualized features and focusing on avoiding negative outcomes (errors)

Figure 1. Two perceptual contrasts combined.

The four cells in Figure 2 illustrate that there are major differences between the ways in which climate-related issues are being framed. Social actors often try to influence each others' frame by using particular communication symbols (framing devices, see Gamson and Modigliani (1989)). Important symbols are historical examples from which lessons are drawn (e.g. the most dramatic recent disaster), metaphors and visual images (e.g. picture of a polar bear). By adopting one of the frames they attempt to open certain positions in favour or against an issue.

The upper right cell of Figure 2 represents distal, moral thinking about climate change. Without going into details, it can be said that Al Gore's movie, *An Inconvenient Truth*, fits well into this pattern, calling for precaution in the face of potentially catastrophic impacts. Next, the reports by the Intergovernmental Panel on Climate Change (IPCC) and the second Dutch Deltacommittee (2008) take a more proximal view, drawing on the latest scientific insights on, for instance, plausible upper limits of regional sea level rise (lower right cell of Figure 2). The reports' publication stimulated a lively discussion on scientific uncertainty. Both Al Gore's

movie and the Deltacommittee report demonstrate the characteristics of a prevention orientation, which aims to avoid errors in dealing with the earth's atmosphere.

	Promotion orientation	Prevention orientation
Distal view	**Social progress frame** defines the issue as improving quality of life or harmony with nature **Middle way frame** puts the emphasis on finding a possible compromise position between polarized views > Plan for a tulip-shaped island	**Morality/ethics frame** defines the issue in terms of right or wrong; respecting or crossing limits **Pandora's box frame** defines the issue as a call for precaution in face of possible impacts or catastrophe > Al Gore, An inconvenient truth
Proximal view	**Economic development frame** defines the issue as investment that improves competitiveness **Conflict/strategy frame** defines the issue as a game among elites, a battle of personalities or groups > Climate Proof City	**Scientific uncertainty frame** defines the issue as a matter of what is known versus unknown **Public accountability frame** defines the issue as responsible use or abuse of science in decision-making > Report IPCC

Figure 2. Science-related frames (adapted from Nisbet, 2009) grouped into four perceptual contrasts, with examples about climate issues.

In turn, both prevention-oriented frames contrast with two promotion-oriented frames. Promotion-oriented frames highlight the possible gains that climate-related issues can entail for society. These frames may be linked to the notion of a "climate proof city", such as the city of Rotterdam, which emphasizes its competitiveness by advertising its various strengths (lower left cell of Figure 2). A more distal view is reflected by the plan for a tulip-shaped island near the Dutch coast, which can be seen as a means of reconciling the objectives of land reclamation and coastal management (upper left cell of Figure 2).

It should be emphasized that Figure 2 is meant to improve our understanding of the various ways in which climate issues may be framed. In addition, the contrasting pairs indicate that none of the frames is a stand-alone guide to an adaptive choice. Each frame has its strengths and weaknesses in articulating the specifics of a situation. Prevention may have to be complemented with promotion (or vice versa), and the distal view of broad strategic planning needs a more implementation-oriented, proximal way of thinking about how measures can be organized. Hence, introducing a contrasting frame may be used to open-up the process of decision-making.

Frames built-in in decision tools

An additional set of frames is necessary to highlight the key elements of decision that should be taken into account in developing an adaptive decision strategy. A crucial consideration is the question whether there is a need for more scientific knowledge or for more deliberation on preferences. Following Thompson's seminal approach to strategy development, the two basic dimensions of decision are beliefs about (1) the

cause/effect relations that are instrumental for what the decision might actually accomplish and (2) preferences regarding the possible outcomes of the decision (Thompson & Tuden, 1959; Thompson, 2003). Depending on the specifics of the situation, both dimensions can take a range of values. However, for the sake of clarity of the presentation, they are often dichotomized: i.e. members of the decision unit perceive certainty or uncertainty regarding causation and certainty or uncertainty regarding outcome preferences.

Figure 3 presents the patterns of uncertainty of the two dimensions. Whether cause/effect relations are uncertain may depend on several conditions, such as the decision unit's belief that the existing knowledge is incomplete, that there is inherent uncertainty or uncertainty due to competition with rivals. Outcome preferences can become uncertain in situations where an individual or organization appears to hold opposing preferences regarding the outcomes of possible actions. An additional type of uncertainty occurs when there are external constraints that make the decision unit dependent on others who hold veto power over some possible preferences. This may happen where regional decision making is restricted by strategic planning processes that are coordinated by governmental institutions and other agencies (Few, Brown, & Tompkins, 2007).

	Preferences regarding possible outcomes	
	Certain	Uncertain
Certain	Causation and outcome preferences are certain – data are voluminous **Computational strategy**	Uncertain due to - opposing preferences - external constraints **Compromise strategy**
Uncertain	Uncertain due to - incomplete knowledge - inherent uncertainty - competition with rival decision-makers **Judgmental strategy**	Uncertain due to - a combination of reasons **Inspirational strategy**

Beliefs about cause/effect relations

Figure 3. The two basic dimensions of decision combined to identify different decision strategies (after Thompson, 2003).

Figure 3 also provides logical links between uncertainties and strategies of decision-making. Members of the decision unit who are confronted with uncertainties regarding causation and outcome preferences should adapt their decision strategy to these issues (Thompson & Tuden, 1959; Thompson, 2003). Provided that there is at least a certain degree of commitment to reaching agreement, they may choose one of the four types of decision strategies.

- If there is certainty regarding both causation and outcome preferences, decision-making is relatively straightforward, although it may require a computational strategy to process voluminous data (upper left cell of Figure 3).

- If outcome preferences are clearly known and shared but cause/effect relations are uncertain or disputed, the decision unit must rely on a judgmental strategy to find a solution (lower left cell of Figure 3).
- In contrast, if cause/effect relations are certain but outcome preferences are uncertain or disputed, the decision unit needs a compromise strategy to identify a common preference (upper right cell of Figure 3).
- Finally, if both causation and outcome preferences are uncertain or disputed, the most likely action of the decision unit is to avoid any decision on the issue, unless an inspirational strategy can be introduced to create a new vision or belief (lower right cell of Figure 3).

Each decision strategy can be elaborated to find methods and tools with built-in frames that fit the strategy. Figure 4 shows a number of options.

	Preferences regarding possible outcomes	
	Certain	Uncertain
Certain	**Computational strategy** Cost-benefit analysis tools Multi-criteria analysis tools Accounting tools and physical analysis tools	**Compromise strategy** Participative tools, e.g. stakeholder analysis and focus groups Argumentation support tools Negotiation tools
Uncertain	**Judgmental strategy** Scenario analysis tools, expert panels, simulation gaming Model tools (biophysical, socio-economic, or integrated) Checklists for judging model quality and uncertainties	**Inspirational strategy** Cognitive aids, e.g. checklists for prompting new ideas Development of learning-scenarios

Beliefs about cause/effect relations

Figure 4. Methods and tools that are relevant for the decision strategies.

A computational strategy (upper left cell of Figure 4) may rely on conventional forms of decision support, such as multi-criteria analysis tools (MCA) and cost-benefit analysis (CBA). The built-in frame of these methods sees the decision situation as a problem for which an optimal solution might exist, provided that trade-offs will be accepted. The notion of trade-offs can be an argument to opt for a transparent, quantitative evaluation of the options. CBA can identify the most advantageous solution or at least those options for which benefits are greater than the costs, because it may attach a monetary value to every aspect considered relevant to society. In fact, this monetarisation is framed as aggregating independent individual choices in a market context. However, CBA is not adapted to long time horizons (> 25 years) and may generate questions about the ethics of interest rates and long-term discounting (Stern, 2007; Turner, 2007).

Alternatively, the decision situation may be framed as a problem whose solution should satisfy a wide set of constraints (upper right cell of Figure 4). Following a compromise strategy, the decision unit may want a course of action that is acceptable to all kinds of stakeholders. To find a common preference, participatory tools can be applied, such as community planning tools, which can be framed as building on

deliberative democratic forums. Such a frame involves some form of open, goal-directed conversation or "dialogue" between decision-makers, experts and other stakeholders, which may create favourable conditions for the exchange of diverging arguments. It should be noted, however, that people with diverging arguments can only communicate meaningfully if their frames overlap to a certain degree (Brockriede, 1992).

Where outcome preferences are clearly known and shared but cause/effect relations are uncertain or disputed, the decision unit must rely on a judgmental strategy to clarify matters (lower left cell of Figure 4). It is in particular the nature and the relevance of scientific uncertainty that can lead to difficult discussions between decision-makers and experts, as well as between experts among themselves (Dessai & Hulme, 2004; Lempert et al., 2004). Insight into the strengths and weaknesses of advanced tools such as influence diagrams (including Bayesian Belief Networks) and dynamic models (including computable general equilibrium models) will require an analysis of critical choices and assumptions. Uncertainty about the impacts of the behaviour of other people on the decision's outcomes may require a game theoretic approach.

Finally, an inspirational strategy may include tools to stimulate creativity, such as the development of learning-scenarios (lower right cell of Figure 4). In fact, there are two diverging frames of creativity. Some persons tend to emphasize the value of spontaneous insight and the magical "Aha!" moment that occurs when a long-sought idea suddenly appears at the conscious level. Other persons emphasize systematic approaches to exploring problems and potential solutions. The occurrence of insight is often associated with restructuring or reframing a problem space, for example, from a broader perspective. Both approaches should be supported by good preparation and the participation of people who have good knowledge about a particular domain and who are able to think flexibly and synthetically.

A closely related strategic consideration is the notion that institutions and groups have organized themselves differently to address different kinds of decision-making problems (Thompson & Tuden, 1959; Thompson, 2003). Hence, when members of the decision unit want to adapt their decision strategy to the uncertainties regarding causation and outcome preferences, they also have to consider the social structures that are appropriate for the issues. Figure 5 displays the most appropriate social structures for each of the strategies.

A computational strategy that is based on cost-benefit analysis, for example, should take into account that this tool can only be applied meaningfully under specific conditions. Compliance with certain rules and conventions regarding the choice of discount rates is crucial to provide comparative insights into the financial costs and benefits of the options. Accordingly, the most appropriate setting for the use of cost-benefit analysis may be a bureaucratic structure that guaranties that every issue is routed to the appropriate specialist (upper left cell of Figure 5).

Preferences regarding
possible outcomes

	Certain	Uncertain
Certain	Computational strategy in a bureaucratic structure	Compromise strategy in a representative structure
Uncertain	Judgmental strategy in a collegial structure	Inspirational strategy in an informal structure

Beliefs about cause/effect relations

Figure 5. Different social structures that fit the decision strategies.

A compromise strategy has to be developed if there is agreement by all parties regarding the expected consequences of the available alternatives but lack of consensus over preferences. The most appropriate setting to handle compromise types of issues economically and efficiently is a representative structure of intermediate size that facilitates detailed and subtle exploration of the several preferences (upper right cell of Figure 5).

A judgmental strategy is called for if causation is uncertain or disputed; this may require a collegial structure, such as a self-governing voluntary group that is competent by virtue of their expertise to make a judgment (lower left cell of Figure 5). If none of the experts has indisputable and complete evidence, no member should be allowed to outvote or override the judgment made by other members and a majority judgment may be necessary.

The fourth type of issue is one in which both causation and outcome preferences are uncertain or disputed (lower right cell of Figure 5). In fact, these conditions make it difficult for all parties to prevent disintegrating tendencies, such as loss of contact or decreasing commitment to reaching agreement. Therefore, the decision unit may try to avoid any decision on the issue, unless a new vision or belief can be developed (Thompson & Tuden, 1959). Harnessing the inspirational aspects of a decision strategy may require an informal setting that offers incentives for collective problem solving. Such a creative kind of activity may be stimulated by charismatic leaders or successful models of new visions.

Generally, the notion that there should be a match between decision strategy and social structure implicates that a decision unit may not be in a position to change its strategy. For example, a decision unit that operates in the context of a bureaucratic structure may not have room for another type of strategy than a computational one. If an organization, such as a planning bureau, adopts one of the four decision strategies as its dominant strategy, it may have to cooperate with other organizations to exercise a different kind of strategy. Alternatively, it may be necessary to create a novel decision unit to address issues for which traditional structures are ill suited.

A final strategic consideration is the relationship between the science-related frames and the decision strategies. Figure 6 illustrates that there may be a loose coupling between the various elements of decision-making. For example, an economic competitiveness frame may give rise to a computational strategy to check the optimum. Similarly, a morality frame may lead to a compromise strategy in order to check the constraints of a morally acceptable solution. A scientific uncertainty frame may require a judgmental strategy to clarify what is known versus unknown. And a social progress frame that aims to reconcile opposing policy objectives may have to be fleshed out by an inspirational strategy. However, these linkages are not the only possibilities and Figure 6 can be seen as a heuristic device.
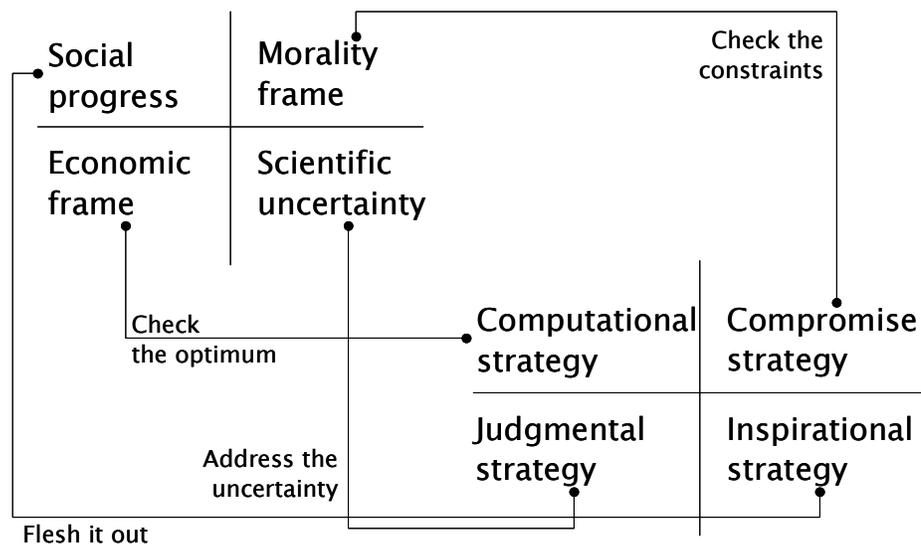
Figure 6. Loose coupling between science-related frames and decision strategies.

Our interaction with a number of adaptation projects at the regional level showed that the information that is summarized in Figure 6 works as an eye-opener for members of decision units. This relates in particular to the exposé of contrasting frames and the way in which they may open-up decision-making. Based on these experiences we have written a tool catalogue in which we present characteristic examples of how various tools mentioned in Figure 4 deal with framing (Wardekker et al., 2009). The examples are meant to demonstrate that it may be very fruitful to use more than one frame and more than one strategy after another. Obviously, strategy development has to be responsive to cues that crucial circumstances are changing or that a strategy is failing. More generally, however, the members of a decision unit should repeatedly ask themselves whether they are still on the right track, as long as the decision process has not been successfully completed.

Discussion and conclusions

This paper has discussed several crucial aspects of frames. Frames can particularly be of help in adding new perspectives to a decision process and in checking whether the participants are able to understand each other. Taken together, the insights on the relationship between science-related frames, uncertainties, decision strategies and

social settings may contribute to a more in-depth understanding of the information tools that can be used to support situated decision-making. A careful consideration of frames in their role of organizing principles may create a better match between supply and demand of information among all the people involved, i.e. knowledge producers, members of a decision unit and stakeholders.

A crucial point is that people can only communicate meaningfully if their frames overlap to a certain degree. If the frames of two persons share too little, they will be unable to co-operate in the same process. For example, due to the technical nature of computational tools, this decision support tool may become counterproductive if its outcomes cannot be shared with members of a decision unit and stakeholders who see themselves as problem owners. If members of a decision unit and stakeholders do not recognize how their input has been incorporated in the analysis, they will loose their trust in the method.

One limitation of the paper is that we did not address the issue of managing the decision process. Thompson and Tuden (1959) already referred to confusion of issues, structural constraints, inappropriate decision units and expansion tendencies in decision issues. As a group changes its beliefs about cause-and-effect relations, for example, types of issues that at one time are identified as appropriate for a judgment strategy may at another time be defined as computational problems, or vice versa. Also, different members of a decision unit may respond to the same situation in different ways, some seeing it as a matter for computation, others as a judgment matter, and still others as requiring bargaining.

If the issue to be decided is linked to serious pre-existing conflicts, strategy development should first create a more neutral starting point. Even then, however, both a judgmental and a compromise strategy may fail due to increasing tendencies of polarization. The heat of debate can lead experts who endorse a particular solution to overstate their case, discount missing information and refer to moral justification for the solution they prefer. When this occurs, the issue is no longer one of judgment but one of compromise. Similarly, an issue that seems fit for a compromise strategy may generate difficulties in the identification of causation. Next, proponents may discount causation theories endorsed by their opponents and dismiss the corresponding "facts". As a result of this polarization, all parties may start to threaten each other with trouble on unrelated matters (Thompson & Tuden, 1959).

Reframing can play an important role in opening-up processes of decision-making (Schön & Rein, 1994). A crucial way to reframe a situation may result from changes in people's mental models of a topic. For example, it may be helpful to put climate change adaptation and mitigation in the context of a higher-level objective, such as sustainable development (Robinson et al., 2006). Emphasizing the functional relationship with sustainable development makes it easier to combine the impacts of adaptation and mitigation with those of other environmental changes. Placing a particular issue in a larger context is not only relevant to handle bargaining issues, but it can also help to crystallize consensus about preferences if the parties involved are unaware of the similarities of their preferences.

Our experiences demonstrate that presenting more than one frame may work as an eye-opener for members of decision units. One of the main drawbacks of a stand-alone frame is that it tends to induce a passive acceptance of the information given. Hence, contrasting frames may be used to stimulate more active participation in decision-making. Because each frame may have its strengths and weaknesses in articulating the specifics of a situation, it may be fruitful for a decision unit to use more than one frame after another. In sum, decision-making may gain from making frames more transparent.

Acknowledgements

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